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A PUBLICATION OF THE WORLD REPORTING SERVICE ON PLANT DISEASES AND PESTS

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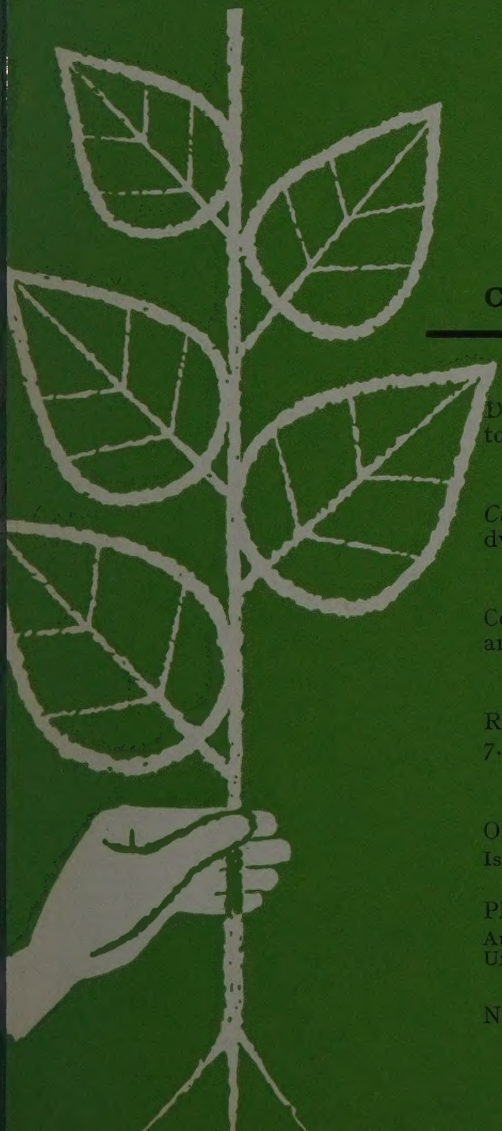

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FAO PLANT PROTECTION BULLETIN

A PUBLICATION OF THE WORLD REPORTING SERVICE ON PLANT DISEASES AND PESTS

Does Cadang-Cadang Disease Spread from Diseased to Healthy Coconut Trees?

Francis O. Holmes, Expanded Program of Technical Assistance, FAO, Manila[1]

The nature of cadang-cadang disease of coconut remains a mystery despite a quarter century of research. No transmissible agent of disease capable of reproducing the characteristic symptoms of the malady has been seen in or on affected trees. The absence of visible pathogens has led to the supposition that a still undetected virus or virus-like agent may cause the disease.

The manner of spread of cadang-cadang disease has tended to confirm the virus causation hypothesis. Surveys have shown that healthy and diseased plants often occur side by side. Moreover, considerable numbers of still healthy trees often fall victims to the disease at different times, one after the other. This more or less random pattern of incidence in space suggests that an arthropod vector of moderate mobility may exist. Yet tests of many arthropod species have failed to incriminate any one of them or to provide definite proof that an arthropod vector is responsible for spread of the disease from tree to tree.

The pattern of incidence in time has been most accurately determined in connection with surveys of plots and roadside strips in southern Luzon. The published results of these surveys[2] show close parallelism between the average rates of spread of disease along various roadsides and in seven carefully studied plots where every individual tree was numbered and observed repeatedly. The surveys of roadside strips and experimental plots were summarized in curves that record the cumulative incidence of cadang-cadang disease in coconut trees of different ages and in different environments.

The epidemiological records as published do not seem to present the picture of an autocatalytic process. Yet one would expect them to do so, to some extent at least, if the increasing number of diseased trees in each area were to constitute a progressively increasing reservoir of inoculum from which spread could occur to the remaining healthy trees.

Comparison of the observed incidence with theoretical curves

In Figure 1, a family of theoretical curves is presented to show the rate of cumulative increase that would be expected if each newly infected coconut tree were to become an additional source of inoculum that might be spread to neighboring healthy trees. The separate curves each start with the assumption of one infected tree in each hundred and show the results to be expected in successive years

[1] The author would like to express his appreciation for help given by Dr. V. C. Valenzuela, Acting Dean of the Institute of Hygiene in Manila, who made useful suggestions in regard to preparation of the manuscript of this paper; thanks are due also to Avelino E. Bigornia, Carlos A. Calica, and Gil O. Pableo for permission to publish the three curves of observed incidence of cadang-cadang disease shown in Figure 6, and to Mr. Jaime L. Nuñez for help in the preparation of illustrations.

[2] Bigornia, A. C., A. C. Calica and G. O. Pableo. 1960. Epidemiological studies on the coconut cadang-cadang disease. Department of Agriculture and Natural Resources, Bureau of Plant Industry, Manila.

if each diseased tree were able to supply enough of the infectious agent to infect ½, 1, 2, 3, or 4 percent of the whole planting each year. These theoretical curves are compared with curves representing the observed results of surveys.

A glance at the curves of Figure 1 will show that the observed results do not at all resemble the theoretical curves. In fact, the curves representing observations in the field are convex where the theoretical curves are concave. The curves that are based on recorded observations have shapes that suggest an opposing hypothesis, to the effect that increase of disease in coconut trees does not produce a correspondingly larger reservoir of inoculum that is transmissible to the remaining healthy trees.

In Figure 2, another family of curves is presented to show the rate of cumulative increase to be expected if the diseased coconut trees were powerless to act as significantly effective reservoirs of inoculum and if essentially all spread within the plot were to originate in a fixed reservoir other than these, possibly consisting of infected weeds or cultivated plants uniformly distributed near the coconut trees. The separate curves show the results to be expected if the hypothetical

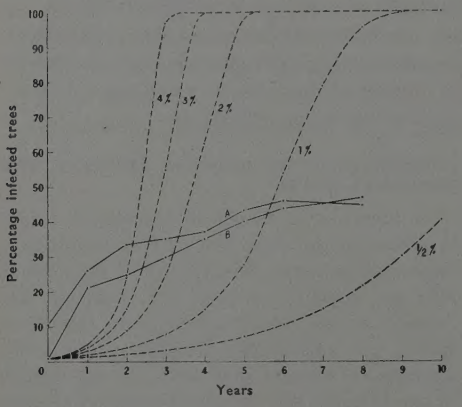

Figure 1. Curves of observed incidence of cadang-cadang disease. A. In roadside coconut trees, and B. in epidemiological plots, contrasted with five theoretical curves, based on the assumption that each infected coconut tree might serve to increase the effective reservoir of inoculum enough to ensure the infection of ½, 1, 2, 3 or 4 percent of the remaining healthy trees each year.

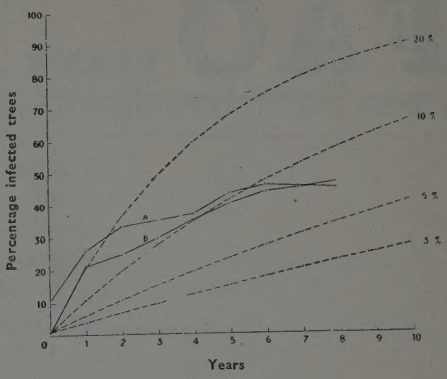

Figure 2. Curves of observed incidence of cadang-cadang disease. A. In roadside coconut trees, and B. in epidemiological plots, compared with four theoretical curves, based on the assumption that infected coconut trees are unable to act as effective reservoirs of inoculum and that other plant species containing enough of the infective agent to infect 3, 5, 10 or 20 percent of the coconut trees each year, are present.

reservoirs should be large enough and if vectors were common enough to infect 3, 5, 10 and 20 percent of the coconut trees each year. In early years nearly all of the infections would involve previously healthy trees, but with the passage of time, as the plot would become more heavily infected, many of the annual transfers of disease would constitute reinfections rather than new infections. Hence the cumulative curves would become progressively less steep from the beginning.

It will be noted that the observed results have a much closer resemblance to the theoretical curves of Figure 2 than to those of Figure 1. Nevertheless, the disease in the field seems to spread much more slowly after a time than would be expected on the theoretical basis on which the broken-line curves of Figure 2 were constructed.

Figure 3 shows the 20 percent curve of the preceding figure modified by the supposition that the effective reservoir loses ability to infect in the same measure that disease of coconut trees increases, as might be expected if there were a gradual reduction in arthropod vector populations, when the shaded conditions under a healthy stand of coconut trees

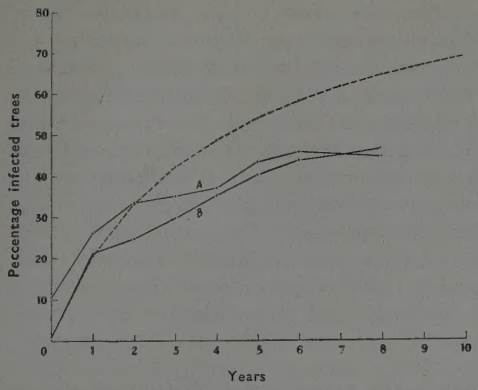

Figure 3. Curves of observed incidence of cadang-cadang disease. A. In roadside coconut trees, and B. in epidemiological plots, compared with a theoretical curve, based on the assumption of a reservoir of inoculum that declines in effectiveness as cadang-cadang disease increases in coconut trees.

give way to more open and sunny conditions in a devastated plantation.

Figure 4 shows the 20 percent curve modified in another way, by the supposition that the hypothetical arthropod vector has some reason to prefer to reinfect already diseased trees rather than to infect previously healthy trees. Such a preference might be based on

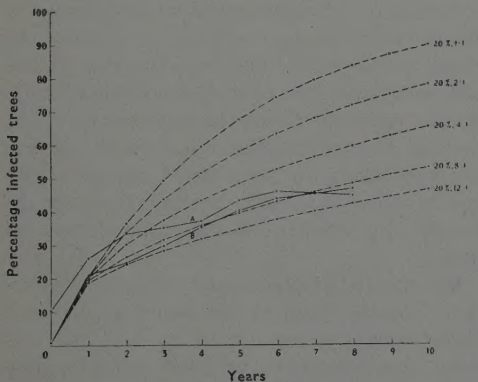

Figure 4. Curves of observed incidence of cadang-cadang disease. A. In roadside coconut trees, and B. in epidemiological plots, compared with five theoretical curves, based on the assumption of enough inoculum in a fixed reservoir to infect 20 percent of the coconut trees each year, but with preferences for reinfecting previously infected trees rather than for infecting new trees. The theoretical curves show no preference (1:1), and 2:1 4:1, 8:1 and 12:1 preferences.

nearness and would be expected to be conspicuous if the reservoir of inoculum were in a plant that does not grow uniformly throughout a coconut plantation but that grows in clumps within or near the observed areas. The preference could, of course, have some other basis than proximity, such as increased succulence or improved attractiveness of form, superficial texture, or flavor of diseased trees. The separate curves show the results to be expected if there were no preference (1 : 1), a 2 : 1 preference, a 4 : 1 preference, an 8 : 1 preference and a 12 : 1 preference.

It will be noted that the previously published curves based on observations of plots in coconut plantations and of trees growing along roadsides show a closer resemblance to the theoretical curves of Figures 3 and 4 than they do to the theoretical curves of Figures 1 and 2. Perhaps the closest resemblance is to the curves of Figure 4, and especially to the 8 : 1 and 12 : 1 preference curves of that figure.

In Figure 5 the curves A and B, derived from field observations, are compared with a theoretical curve C, that gives a slightly better fit than any of those presented in preceding figures. This is a curve representing 25 percent infection each year from a fixed reservoir so located, or of such a nature, that previously infected trees tend to become reinfected twelve times as readily as new trees become initially infected.

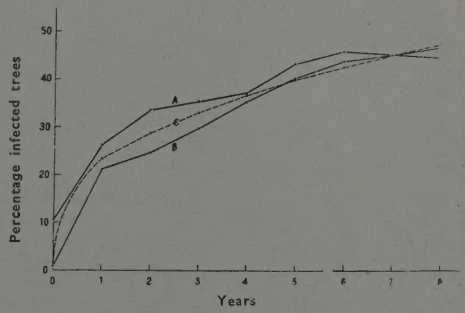

Figure 5. Curves of observed incidence of cadang-cadang disease. A. In roadside coconut trees, and B. in epidemiological plots, compared with a theoretical curve (C), based on the hypothesis of 25 percent spread annually from a reservoir independent of coconut, with a 12:1 preference for reinfection of already affected trees rather than for initial infection of additional trees.

The fit for this curve seems entirely satisfactory, especially when it is recognized that the curve based on observation of trees along roadsides has appeared to drop somewhat in recent years, whereas the disease in surveyed plots has continued to increase slightly. The apparent drop in roadside disease is believed to be due to undetected removal of part of the dying trees. Stumps of trees that have been cut and removed can be found sometimes, but often they escape observation in roadside surveys. In plots that are examined repeatedly, this source of inaccuracy does not exist, because the trees are numbered and a precise record is kept of all of them. Hence the curve representing the average for the epidemiological plots is to be preferred for comparison with the theoretical curve.

It is possible, of course, that coconut trees after infection may act as highly inefficient sources of inoculum for spread of disease to other trees. We may conclude from the available evidence, however, that some source of disease other than infected coconut trees does exist and that affected coconut trees contribute either not at all or very little indeed to dissemination of cadang-cadang disease.

In order to show something of the nature of differences between individual plots, examples of the progressive spread of cadang-cadang disease in three separately surveyed plots are shown in Figure 6, together with three theoretical curves based on the assumption of an effective reservoir of disease that does not reside in coconut but in or on one of several weeds that are not uniformly distributed throughout the observed coconut plantations and that tend to grow in clumps or colonies near or within the observed plantations. The curves of the actual observations are included here by permission of Messrs. Bigornia, Calica and Pableo, who published a curve representing the average of seven plots but none of the single-plot observations.

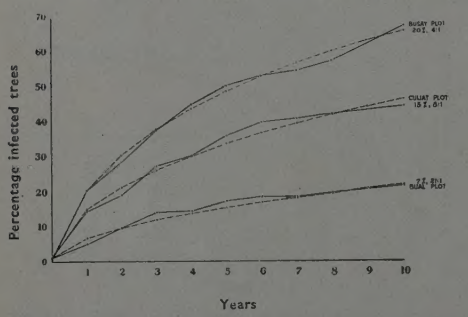

Figure 6. Differing incidences of cadang-cadang disease in three epidemiological plots, compared with theoretical curves, based on the concept of no transmission from coconut to coconut, but of transmission from static reservoirs in weeds differing in total capacity and in degree of clumping in the three plots.

Differences between hypothetical reservoirs in plots

The observed differences in rate of spread in the individual plots seem to require the assumption that there may be more nearly uniform distribution of reservoir plants in some of the plots than in others, and that there may be a larger total reservoir capable of initiating more rapid spread of cadang-cadang disease in some plots than in others.

Thus to obtain approximate agreement of a theoretical curve with the observed curve of incidence of disease in the Busay plot, it was necessary that the theoretical curve should be based on an assumption of a reservoir of disease large enough to produce infection in about 20 percent of the coconut trees of the plot each year, but of a clumped distribution of the reservoir plants throughout the plot, so that already affected trees would be four times as likely to be infected again in any one year as previously healthy trees are to be initially infected in the same length of time.

For the Culiat plot, about 15 percent infection annually had to be assumed, and the fewer sources necessary to account for this lower rate of infection would logically be more widely separated from each other and from the average coconut tree in the plantation. Approximate agreement with the observed data was obtained by the assumption that in this plot already infected trees would become reinfected about eight times as frequently as additional trees become infected.

For the Bual plot, it was found necessary to assume about 7 percent infection in each year, with a distribution of the effective reservoirs of disease so uneven that affected trees would tend to be reinfected about 21 times as often as new trees are infected there.

If the cause of cadang-cadang disease were not a virus or a virus-like agent but a tiny ectoparasite such as a microscopically small mite, the curves represented in Figures 1 to 6 would apply equally well. What seems to be implied by the curves that represent the observed rate of spread of disease is an essentially static or slightly declining effective reservoir of disease, occurring in spots or clumps that are near but neither in nor on infected or infested coconut trees.

This hypothesis, that the affected coconut tree in general represents what may be called a "blind alley" for the disease and that the significantly effective reservoir of cadang-cadang disease is independent of coconut trees, has two important implications. It would suggest that the removal and disposal of affected coconut trees is unimportant, or at least relatively unimportant, in any attempt that may be made to control spread of the disease. It gives substantial reason to hope, also, that the active and important reservoir of disease will be found in or on some weed plants or cultivated plants that are not essential to the copra industry and that may be removed from plantations and thus rendered ineffective in further spread of the disease.

Calligypona marginata, the Vector of Maize Rough Dwarf Virus

I. Harpaz,[1] Hebrew University, Faculty of Agriculture, Rehovot, Israel

The rough dwarf disease of maize was first described (1) in 1949 from Italy, where it is known as *il nanismo ruvido*. Its viral nature, however, was not demonstrated until 1959 (5). The vector of this virus had hitherto been unknown, though Klinkowski and Kreutzberg (9) erroneously inferred from a paper by Sibilia (15) that the aphid *Tetraneura ulmi* (L.), occurring on maize roots in Italy, was the vector of this disease.

Insect transmission

Transmission trials carried out in Israel during the past two years, using 11 different species of insects, have so far established only the Araeopid planthopper *Calligypona marginata* (F.) = (*Delphacodes striatella* [Fallén]) as the vector of the maize rough dwarf virus. Repeated attempts to transmit this virus by any of the following insect species invariably failed.

APHIDS

Rhopalosiphum maidis (Fitch)
R. padi (L.)
Macrosiphum fragariae (Walker)
Sitobion avenae (F.)
Schizaphis (*Toxoptera*) *graminum* (Rondani)

LEAFHOPPERS

Euscelinae
Balclutha hebe (Kirkaldy)
Cicadulina bipunctella (Matsumura)
Typhlocybinae
Erythroneura coacta Ribaut
Flatidae
Phantia subquadrata (Herrich-Schäffer)

Incidentally, *Tetraneura ulmi* (L.) does not occur in Israel, while the disease is widespread in the country wherever maize is grown.

In the first series of transmission trials with *Calligypona marginata*, the insects were placed in groups of 5 to 10 individuals, inside small glass cages, which were clipped onto leaves of two-month-old maize plants showing typical stunting and leaf symptoms of rough dwarf. These source plants were selected from a field of hybrid maize with a considerable percentage of naturally infected plants. Following a feeding period of varying lengths, the planthoppers were transferred into larger cages containing ten-day-old hybrid maize seedlings of the variety Nevé Yaar 22 (single cross) for inoculation feeding of various lengths of time. This series involved nearly 200 test plants, on which the adult insects of both sexes and both macropterous and brachypterous forms, as well as larvae, were fed. None of these test plants had developed rough dwarf symptoms. It should be pointed out that the survival of *Calligypona marginata* on maize plants in Israel is remarkably poor, nor does this species breed naturally on maize in this country. In summer, for instance, they did not live on maize more than 7 days, and in winter in an unheated greenhouse not more than 17 days, with the majority of insects dying in either case after a shorter period. This may account for the failure of this species to transmit the virus directly from one maize plant to another, as it is obvious that such a brief life span is not long enough to complete the cycle of acquisition-multiplication-inoculation of the virus.

In the second series of transmission trials, the lives of the insects were prolonged by transferring them to Bermuda grass (*Cynodon dactylon*) and nut grass (*Cyperus rotundus*), following an acquisition feeding of 24 hours on infected maize plants. On these two grasses, *Calligypona marginata* feeds and breeds readily.

[1] The author is indebted to Mr. Shing-lin Li of the University of Wisconsin for the translation of Japanese papers, and to Dr. E. Swirski of the Agricultural Research Station, Beit Dagan, Israel, and Dr. R. Linnavuori of Raisio, Finland, for their help in the identification of homopterous specimens. Mr. D. Heller's valuable technical assistance is also hereby acknowledged.

After feeding for 20 to 25 days on Bermuda or nut grass, the insects were placed on hybrid maize seedlings of the same variety and age as used in the first series of trials, at the rate of 15 insects for each plant. After an inoculation feeding of 24 hours, the hoppers were removed and the plants were sprayed with a malathion emulsion. After 15 to 20 days, 4 out of 13 plants, in two replications, showed typical rough dwarf symptoms.

On one occasion, transmission of the disease to maize was obtained by the use of the offsprings of the insects that were fed on diseased maize plants. The offsprings were reared on Bermuda grass to permit virus multiplication and were then transferred to maize plants. Since the eggs were hatched on the same Bermuda grass plants on which the parent insects had fed, the success of infecting maize plants did not provide evidence sufficient to indicate that the virus was transmitted from parent insects to progeny. Bermuda grass, after the insect feeding, also showed symptoms, consisting of a slight stunting of growth and occasional necrosis of young leaf tips. Those symptoms were ephemeral and could be attributed rather to the direct injury of insect feeding; however, it is not yet known whether Bermuda grass is immune to the virus and whether it can act as a symptomless carrier.

In one single test, which could not be repeated, transmission of the virus was obtained by a related species, *Calligypona propinqua* (Fieber), which also does not breed on maize but on Bermuda grass.

Seed transmission

A test was carried out to investigate the transmissibility of the virus through seed. Over 500 seeds were collected from maize plants in the field, which had shown rough dwarf symptoms, but obviously had escaped the severe stunting and lethal effects and developed a number of atrophied ears, as described by Grancini (2) and by Harpaz (4). None of the plants grown from those seeds which were kept under insect-proof conditions showed any rough dwarf symptoms at any stage of development. It is therefore assumed that the virus is not seed-borne.

Field observations

The failure of the vector to develop on maize may account for the obvious lack of spread of the virus from infected maize plants to healthy ones in the field. The withering of Bermuda grass at the end of the rainy season in winter induces the adult planthoppers to migrate to irrigated maize fields, where they feed on young seedlings, causing infection sometimes as high as 70 percent or more. This usually occurs during the second half of April and the first half of May, depending on the weather. With the onset of the hot and dry summer, the population of *Calligypona marginata* in the maize fields decreases rapidly, as breeding of this insect does not take place on maize. Consequently, from the beginning of June, hardly any new infections take place. A similar situation was reported from northern Italy (3) and from the Zaragoza county in northeastern Spain.[2] In those two areas, the period during which the infection takes place is about three to four weeks later than that in Israel, due to the cooler weather in spring.

In Israel, *Calligypona marginata* does not seem to undergo a winter diapause, as it does in Japan (8) or in Siberia (16). According to the observations of Swirski (17) and the writer, the adults are active throughout the year. The peak of the population is reached during April, and the ebb during July to September, the hottest months of the year. This population trend agrees fully with the previously described pattern of the disease incidence in the field.

Following a severe outbreak of the disease in Israel during the early summer of 1958 (6), farmers were advised during the 1959 and 1960 seasons to delay the sowing of maize until the last week of May, so that the maize seed sown in the field would not germinate before June. A country-wide survey carried out later

[2] Personal communication from Mr. Angulo Busquets, 1958.

in the season revealed that by merely applying this simple cultural method, the incidence of the disease had decreased from an average of 45 percent in the early-sown check plots to an average of no more than 3 percent in the late-sown fields. Infection as low as 3 percent is obviously without any economic significance. In cases where early sowing was unavoidable, the young plants could be protected against the vector by a weekly spraying of the emulsion of parathion, malathion or DDT, until the insect population decreased.

Relationship with other viruses

Calligypona marginata has been reported as a vector of some other virus diseases of graminaceous plants, namely, oat pseudo-rosette (*zakuklivanie*) in Siberia (16), and northern cereal mosaic (7) and rice stripe (10, 19) in Japan. The former two viruses are closely related but the virus causing rice stripe is entirely different (7), even though they are all transmitted by the same insect.

A reference made by Watson and Sinha (18) to *Delphacodes striatella* Fallén being the vector also of winter wheat mosaic virus in the U.S.S R was a mistake, as the vector of that virus is actually *Deltocephalus* (*Psamotettix*) *striatus* L. (20), which belongs to a different superfamily of the order Homoptera. Incidentally, the same error was repeated in a later review on leafhopper-transmitted plant viruses by Maramorosch (12).

In 1952, Kuribayashi and Shinkai (11) described another disease carried by the same vector under the name of rice black-streaked stunt. According to Yamamoto,[1] the symptoms caused by rice black-streaked stunt virus on maize are as follows: "severe stunting of growth, darker green leaves with no apparent mottling, numerous swellings along the veins on the lower surface of the leaves as a result of the abnormally enlarged phloem cells." Those symptoms are similar to the symptoms of maize rough dwarf as described in Italy (2) and in Israel (4). Since both have the same vector, the two diseases could be caused by closely related viruses. On the other hand, Maramorosch *et al.* (13) had recently demonstrated that leaf galls originating from vein enlargements could be induced on maize leaves by the mere feeding of several species of leafhoppers without transmitting any virus. Therefore, vein swelling is a symptom of hardly any diagnostic value. Moreover, repeated attempts to transmit maize rough dwarf to rice plants by the vector were unsuccessful, and a field survey failed to reveal on rice plants symptoms similar to those of black-streaked stunt. This survey covered a number of Japanese rice varieties, such as *Shinshu*, which came from the Nagano and Tokyo districts in Japan, where black-streaked stunt is most prevalent (11). Also, on the plain of Lombardy, in Italy, where rice and maize are grown adjacently and where *Calligypona marginata* occurs, a disease like black-streaked stunt has never been reported on rice, whereas maize rough dwarf is widespread. As plant quarantine regulations do not allow the importation of virus-infected material, cross-inoculation with maize rough dwarf and rice black-streaked stunt could not be made to establish their relationship. The virus causing black-streaked stunt is therefore being regarded as different from all the other viruses mentioned here.

Host relations

In Israel, as well as in Italy and Spain, the incidence of maize rough dwarf is much higher in the introduced American hybrid varieties than in local varieties. The disease does not seem to be a recent introduction in the Mediterranean area, but due to its low incidence in local maize varieties, it was probably unnoticed for many years. The introduction of the highly susceptible hybrid varieties from the United States finally brought it to attention.

So far the disease has not been found in wheat, oats, barley or sorghum. The possibility however exists that these cereals, as well as some other graminaceous plants, may serve as symptomless carriers of the virus.

Another possibility for the virus to survive through the period of absence of host plants

[1] Personal communication from H. Yamamoto, 1959.

was indicated by Shinkai (14), who discovered that the rice black-streaked stunt virus could pass transovarially through the egg of an infective female planthopper into its progeny. Even after seven generations, no decline of infectivity was noticed through such passages. The indication of such a possibility in maize rough dwarf was mentioned previously in connection with transmission trials. In that case, the reservoir of the virus in nature is not among alternate host plants but within the vector itself.

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Correlation of Cadang-Cadang Disease in Coconut and Certain Diseases in Weeds

Francis O. Holmes, Expanded Program of Technical Assistance, FAO, Manila [1]

Surveys of cadang-cadang disease in coconut trees growing along roadsides and in plots within plantations were described by Bigornia, Calica and Pableo (1). These surveys provided accurate records of the incidence of cadang-cadang disease in the Bicol region of the Philippines over a ten-year period.

The published data from these surveys, depicting the average rates of spread from year to year, do not seem compatible with the supposition that affected coconut trees constitute effective reservoirs of cadang-cadang disease from which spread can occur to neighboring healthy coconut trees (2). The survey data, indeed, appear to require the hypothesis that there exists a reservoir of quite another kind. This reservoir must be essentially fully developed and static or declining before coconut trees begin to become affected in appreciable numbers near it.

The purpose of the present paper is to describe efforts that have been made recently to identify this predicted reservoir of disease.

Search for predicted reservoir of disease

An effort was made in 1961 to discover parts of Albay Province not yet affected by cadang-cadang disease. It was hoped that such areas could be compared to advantage with nearby areas of unusually severe devastation and that the result of such comparisons would be the recognition of some plant or plants, whether symptomless or obviously affected by disease, that would be highly correlated with the incidence of cadang-cadang disease locally.

This effort failed, because no substantial part of Albay Province could be found free from cadang-cadang disease in coconut. Comparisons of more distant areas, such as those in other provinces, with the severely devastated parts of Albay Province, seemed unlikely to lead to identification of an effective reservoir, because many differences in flora would be expected on purely geographical considerations, without any likelihood of causal correlation with disease incidence.

Plans were then changed to determine whether low-incidence areas within Albay Province might be contrasted to advantage with nearby high-incidence areas. This plan of attack on the problem proved successful.

A re-examination of some of the surveyed plots and roadside strips confirmed the impression of those who had made the earlier surveys that a number of weed species show an obscurely characterized malady in the immediate neighborhood of cadang-cadang-affected coconut trees. The disease in question commonly causes yellowed and sometimes reddened leaf edges, slightly stunted growth, sometimes thickened and roughened veins, and even enations on the lower sides of veins. The question, of course, is whether this disease in weeds is a counterpart of cadang-cadang disease of coconut.

Many earlier investigators have noted the presence of diseased weeds near infected coconut trees and have given some consideration to their possible significance. Perhaps the use of qualitative rather than quantitative methods has discouraged more intensive investigations in the past. The weeds are to be found, and sometimes show disease, beyond the recognized limits of occurrence of cadang-cadang disease of coconut. This fact may have proved confusing to any investigators who were seeking a 1 : 1 correlation between diseased weeds and diseased coconut trees. It is known now that the published epidemiological data require an effective reservoir of inoculum that is fully

[1] The author wishes to express his appreciation to Mr. Jaime L. Nuñez for help in the preparation of illustrations used in this paper.

developed before coconut trees begin to acquire disease to an appreciable extent. It should therefore be expected that the weed disease would precede the disease in coconut if the latter were dependent on the former.

If the weeds that are now under consideration should prove to be susceptible to cadang-cadang disease, it must be realized that some of them, like coconut, may be more or less blind alleys for the causative agent, and that others may prove to be effective reservoirs of inoculum and of arthropod vectors capable of transferring disease to nearby coconut trees. It is even possible that some species may prove to be blind alleys for the disease in some areas and effective reservoirs of inoculum in others, depending on the vector species present.

Notable among the diseased weeds in cadang-cadang-affected plantations is the species *Elephantopus mollis* HBK (Compositae), which is shown in Figure 1. It seems to have been introduced into the Philippines from Mexico. Merrill (3) recorded it as occurring in the Orient only in the Philippines and in Guam. *E. mollis* is present in nearly all coconut plantations of the Bicol region of the Philippines, often in very large numbers. It seems to be relatively easy to control, in the sense that it does not occur to an important extent within frequently cultivated areas, such as those planted with beans, peanuts, sweet potatoes or maize. It is largely eliminated if overgrown by taller plants of any kind, being relatively intolerant of shade.

A related species, formerly classified in the genus *Elephantopus*, seems to be involved much less often. This species, now known as *Pseudoelephantopus spicatus* (Juss.) Rohr., remains healthy in appearance in many areas even when nearby plants of *E. mollis* are seriously damaged.

A third weed that seems to be affected at times, and even to show enations like those found in some plants of *Elephantopus mollis* and *Pseudoelephantopus spicatus*, is *Stachytarpheta jamaicensis* (L.) Vahl. (Verbenaceae). This plant, like *P. spicatus*, often remains healthy despite the occurrence of much disease

Figure 1. Leaves of *Elephantopus mollis* HBK; healthy leaf at right, diseased leaf at left.

in nearby plants of *E. mollis*. It may prove to be of importance only occasionally, if ever.

Comparable damage occurs occasionally also in other plants, including *Passiflora foetida* L. (Passifloraceae), *Synedrella nodiflora* (L.) Gaertn. (Compositae), and *Malachra capitata* L. (Malvaceae).

Correlation surveys

An attempt was made during 1961 to establish a quantitative correlation between the presence of substantial numbers of affected plants of *Elephantopus mollis* and the occurrence of cadang-cadang disease in coconut trees. Despite

the fact that the incidence of disease in the weeds must be observed and evaluated in the current year, and the incidence of disease in coconut as seen today in the field represents in large part the accumulation of infections over a long series of years, considerable success has been attained in demonstrating a positive correlation between the two. Discrepancies do not seem to be common or large. This may mean that patches or clumps of the weed tend to remain almost equally abundant in given locations in successive years. They reseed themselves there, and the spots that have proved well suited to their survival during one year are likely to be better suited than other spots for their growth in subsequent years.

It is easier to ascertain the incidence of cadang-cadang disease in coconut than it is to appraise objectively the degree of coexisting damage in weed populations, even though qualitatively it is easier to recognize the weed disease in plants near at hand than to detect some of the symptoms of cadang-cadang disease in coconut foliage high overhead. Nevertheless, an effort has been made to apply quantitative methods objectively to each part of the problem.

Appraisal of the incidence of cadang-cadang disease in coconut has been reduced to a relatively exact procedure at the Guinobatan Experiment Station in Albay Province. A team of staff members and assistants, trained by senior members of the staff, is now capable of surveying plots and roadside strips with satisfactorily reproducible results. Each member of the team is provided with a hand-manipulated counter. One man records healthy coconut trees within a specified area or distance from the roadside, and another records cadang-cadang-affected trees in the same location. In making surveys along the sides of roads, two workers operate from one side of a moving vehicle, such as a station wagon or jeep, and two others operate from the other side. The vehicle moves at speeds of approximately 10 kilometers an hour, the driver adjusting the speed in accordance with the number of trees to be examined in each portion of the road. A stop is made at each kilometer post to record results and reset counters to zero.

The survey team [2] has operated recently not only to extend the curves of incidence formerly recorded in the Bicol area of Luzon but also to identify individual kilometer stretches of roadside that are of special interest. The portions of roadside of unusual interest for further study are those characterized by very high or very low incidence of cadang-cadang disease, or those in which the incidence of disease in coconut seems at variance with preliminary appraisals of damage to weeds.

Records of cadang-cadang disease from different strips along roads differ notably among themselves, just as do records of individual plots that have been surveyed and resurveyed over a long series of years. The existing variation among roadside strips is shown in Figure 2. It will be observed that single-

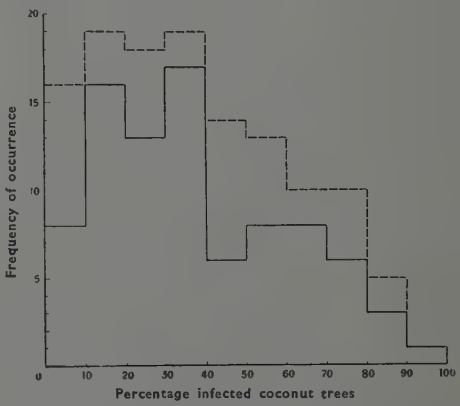

Figure 2. The frequency of different percentages of cadang-cadang disease in coconut trees along roadsides in Albay Province during 1961. Under the unbroken line are represented areas in which 100 or more coconut trees were observed within strips of land 30 meters wide along 1 kilometer of roadway; under the broken line are represented similar areas in which at least 50 coconut trees were observed. Generally, such areas were adjacent to substantial plantings somewhat more distant from the edge of the road.

[2] The members of the survey team during the course of the work described here were Gil O. Pableo, Jaime L. Nuñez, Jesus Patola, Santos Obaña and Mariano Osma. They worked on the above project under the direction of Carlos A. Calica. The author wishes to express his gratitude to his co-workers, without whose co-operation this study could not have been completed.

kilometer lengths of road that include more than 100 coconut trees within 30 meters of the roadside, as shown under the solid line of the figure, are rarely less than 10 percent affected by cadang-cadang disease, or more than 80 percent affected in the observed areas, which represented much of Albay Province in Luzon during 1961; similar areas that include more than 50 coconut trees each, represented by the area under the dotted line, tend only to confirm this.

In making roadside surveys, usually the highest and lowest or the two highest and two lowest records of disease were re-examined and confirmed or corrected on the return toward the laboratory, with a view to plotting the results graphically.

Figure 3 presents a summary of 20 observations of intensity of the disease reservoir in weeds as correlated with incidence of cadang-cadang disease in coconut at the same locations. The graph includes the results at the most outstanding part of each selected kilometer of roadside. An evaluation of the amount of disease in weeds is made by examining both the roadside and the nearby land within the plantations. An index number is agreed upon

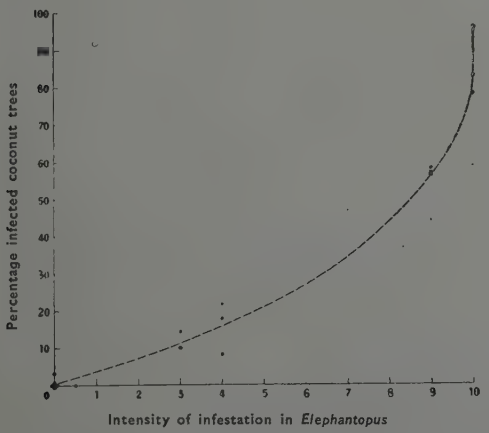

Figure 3. Correlation between intensity of disease reservoir in the weed species, *Elephantopus mollis* HBK expressed in grades from 0 as minimum to 10 as maximum, and the percentage incidence of cadang-cadang disease in coconut at 20 locations. An exceptional record shown in the upper left corner of the graph is discussed in the text.

to represent the degree of infestation of *E. mollis*, using the value of 10 as maximum and 0 as minimum.

It will be observed from examination of Figure 3 that most of the observations have fallen along a line that would be expected from the consideration that the weed reservoir may not be very effective until it has reached a degree of infestation close to its own maximum, as had been anticipated (2).

Odds for the assumption that there is a logical relationship between the intensity of disease in weeds of the species *E. mollis* and that in coconut, can be computed on the theory that a high value in coconut might equally well be matched by a low value or a high value in the weeds, if no connection between the two existed. Hence the chance that both will be high or that both will be low is only one in two at each location, on a random association hypothesis, and in general will be $1 : 2^n$ for n locations.

Only one notable exception to this correlation has been observed up to the present time in surveys within Albay Province. It seems to be the kind of exception that tends to prove, and perhaps to interpret, the rule.

In a location near Libon, very high incidence of cadang-cadang disease in coconut occurred in an area characterized by the presence of some, but relatively few, diseased plants of *E. mollis*. In this location, recurrent flooding of the land seemed to have been an adverse influence in the growth of this weed. There were unusual amounts of disease in the weed *Stachytarpheta jamaicensis* nearby. Moreover, the weed *Passiflora foetida* was both abundant and without exception diseased, a circumstance not observed elsewhere in the course of the surveys.

The excessive spread of disease in coconut in this location, and the unusual amount of involvement of weeds other than *E. mollis*, may represent the effects of a tendency for insects that normally remain on *E. mollis* to be forced off this plant locally by floods. Whether the other weed species act as supplementary effective reservoirs of disease or only as supplementary indicators of disease incidence,

is a question that can be answered only by further research. In any case, this exceptional location, which is included in the upper left-hand corner of the correlation chart in Figure 2, seems to emphasize rather than to detract from the part played by weeds in the cadang-cadang problem, since it is characterized by less disease in *E. mollis* than in coconut, but by correspondingly higher incidence in other nearby weed species.

The observation that there is a high degree of correlation between the incidence of cadang-cadang disease in coconut and the presence of disease in certain weeds raises the question whether spread of disease among coconut trees might be slowed, or even stopped, by removal of the diseased weeds. Studies are being made of insects that occur on diseased plants of *E. mollis* and that do not occur to the same extent on healthy plants of this species. Before transmission tests can be completed, some individuals and agencies in the Philippines may want to experiment with removal of the diseased weeds from plantations. If artificial removal of the weeds should be followed by cessation of spread of cadang-cadang disease in coconut, as seems to be the usual result in nature when the weeds are not present, a promising and rational method of control may be on hand. Only experimentation can demonstrate this. Removal of affected weeds in areas newly invaded by cadang-cadang disease, where these weeds have been observed to be present but to be relatively few in number thus far, may be especially helpful on an experimental basis, to disclose whether or not the disease can be forced to retreat from the southern part of Quezon Province and prevented from extending into the extensive coconut-producing areas in Laguna and Quezon Provinces that lie north of all presently recognized outposts of cadang-cadang disease.

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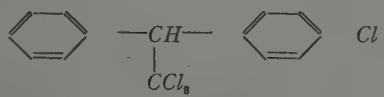
Recommended Analytical Methods for Pesticides

7. DDT TECHNICAL [1]

Collaborative Pesticides Analytical Committee, c/o Plant Pathology Laboratory, Harpenden, Herts, England

This paper describes methods of analysis for technical DDT.

DDT is used here as the recommended common name for technical dichlorodiphenyltrichloroethane, a complex chemical mixture in which pp'-DDT predominates. The term pp'-DDT is the recommended common name for 1,1,1-trichloro-2,2-di-(4-chlorophenyl) ethane.



Empirical formula $C_{14}H_9Cl_5$

Molecular weight 354.3

Melting point (pp'-DDT) 108.5°C.

Sampling

Sampling requires great care and it is important to follow the sampling instructions carefully in order that the sample shall represent, as far as possible, the average composition of the product.

Take a bulk sample of between 200 and 500 gm., which is obtained by taking a number of individual small samples uniformly selected from the product being sampled.

To make the final sample for analysis, mix the bulk sample, crushing any lumps present, so as to make it homogeneous, and then reduce by the method of quartering to produce a final sample of, or slightly more than, 20 gm.

[1] This method was accepted in June 1961 by the Collaborative Pesticides Analytical Committee (CPAC), which consists of scientists from 11 European countries having a substantial chemical industry. The original method is in French.

Preparation of samples

Divide the final sample into four parts of about 5 gm. each. Dry them by the procedure given below to determine the content of water and volatile materials, and then reunite them into one sample. Finely grind this sample, mix carefully, and use for the other determinations given below.

Determination of water and volatile products

Principle. Dry a 5 gm. sample for one hour at 60°C.; the loss in weight represents the content of water and volatile products.

Apparatus

Weighing bottle, squat form, 50 mm. × 30 mm., with ground glass lid tared

Oven, thermostatically controlled at 60°C.

Desiccator

Balance, accurate to 0.1 mg.

Procedure. Crush any lumps in the sample; spread it in a thin layer in the tared weighing bottle (x gm.), and weigh (w gm.). Place the bottle in the oven at 60°C. for one hour. Remove, place in the desiccator, allow to cool, and reweigh (z gm.).

Percentage w/w of water and volatile products $= \dfrac{100\ (w - z)}{(w - x)}$

Add the sample from the weighing bottle to the other three portions dried under the same conditions (see "Preparation of samples").

Determination of organic chlorine

Principle. The organic chlorine is converted to inorganic chlorine with potassium ethyl-

ate, which is then titrated with ammonium thiocyanate.

Reagents

Xylene
Potassium
Ethanol, absolute
Nitric acid, specific gravity 1.33, chlorine-free
Phenolphthalein, 1 percent ethanolic solution

Apparatus

Weighing bottle
150 ml. flat-bottomed flask with ground glass neck
Reflux condenser to fit
500 ml. conical flask
Balance, accurate to 0.1 mg.
Water bath
10 ml. measuring cylinder
25 ml. measuring cylinder
50 ml. burette

Procedure. Weigh accurately to 0.1 mg. about 0.2 gm. (*w* gm.) of the previously dried sample and transfer to the flat-bottomed flask, containing xylene (5 ml.), and add potassium (about 1.5 gm. in four or five pieces). Attach the condenser to the flask. Heat the mixture gently till boiling and reflux for 30 minutes, allow to cool, then add through the condenser ethanol (10 ml. in 2 ml. aliquots) and again boil for 10 minutes. Allow to cool, after making sure that all the potassium has disappeared. After cooling, detach the condenser, add distilled water (25 ml.) and transfer the contents to the conical flask. Wash the first flask twice with distilled water (2 × 20 ml.) and add the washings to the solution in the conical flask (Note 1).

Neutralize the solution with the nitric acid in the presence of the phenolphthalein. Add 1 ml. of nitric acid in excess. Titrate the solution with the thiocyanate or determine the chlorine ion electrometrically.

Express the results as percentage organic chlorine based on the dried sample.

NOTE 1. Alternatively, the following procedure may be used. Add to the sample in the flask isopropanol (25 ml. of perfectly dry 99 percent isopropanol), shake and add sodium in the form of ribbon or small pieces (2.5 gm.). Attach the reflux condenser to the flask, heat the mixture gently to boiling and reflux for at least one hour, shaking the flask from time to time. Remove the excess sodium, by adding cautiously 50 percent aqueous isopropanol one or two drops at a time down the condenser (10 ml.). Boil for a further 10 minutes, add distilled water (60 ml.) and transfer the contents of the flask to the conical flask. Continue as above from "Wash the first flask...."

Determination of 1,1,1-Trichloro-2,2-di (pchlorophenyl) ethane

Principle. The sample is dissolved in aqueous ethanol, previously saturated with pure *p,p'*-DDT, at a selected temperature T°C. (Note 1). The *p,p'*-DDT is allowed to crystallize out at temperature T, filtered off and weighed.

Reagents

p,p'-DDT, pure
Ethanol, 75 percent aqueous solution; made from 75 parts of 95 percent ethanol and 25 parts of water
Acetone, anhydrous
Active carbon (Note 2)

Apparatus

Constant temperature water bath, thermostatically controlled to 0.1°C. (Note 1)
3,000 ml. conical flask
Two 500 ml. conical flasks with ground glass necks and stoppers
Reflux condenser to fit
Sintered glass crucible, porosity G3 or G4, 5 to 15 microns
500 ml. filter flask and adapter for the crucible
Oven at 60°C.
Balance, sensitive to 0.1 mg.
Water bath
250 ml. measuring cylinder
25 ml. measuring cyclinder

Procedure

(i) *Preparation of the p,p'-DDT stock solution.* Saturate about a liter of the ethanol with an excess of pure *p,p'*DDT at a temperature above

T°C. in the 3-liter conical flask and place the flask for several hours in the constant temperature water bath at T° ± 0.1° C. (Note 1) before use.

(ii) *Determination of the p,p'DDT.* Weigh accurately about 2 gm. of the sample (*w* gm.) in a tared 250 ml. conical flask. Dissolve the sample in acetone (150 ml.), add active carbon (2 gm., Note 2), and shake for two to three minutes. Filter through the sintered glass crucible, porosity No. 3 (Note 3) into a 500 ml. conical flask, then rinse and wash four times with acetone (4 × 25 ml.) (Note 4). Remove the acetone on the water bath at a temperature not greater than 70°C., then dry in the oven at 70°C. (Note 5).

Add the stock DDT solution (150 ml.) to the flask, attach the reflux condenser, and dissolve the residue, which has been purified with decolorizing charcoal, by refluxing on the water bath. When it has dissolved, detach the condenser, stopper the flask, and allow it to cool to about 25° to 30°C. Crystals of *p,p'*-DDT are usually deposited during this cooling, but if no crystals are formed, seed with a pure crystal of *p,p'*-DDT. Place the flask in the constant temperature water bath at T° ± 0.1° C., and leave there for about four hours, shaking the flask frequently without removing it from the bath.

Bring the sintered glass crucible, porosity G3 (Note 6) to T° C., by placing it in the constant temperature water bath. Then assemble the filtration apparatus and rapidly filter the contents of the conical flask. Before the filter is sucked dry, the conical flask is washed twice with the stock solution (2 × 10 ml.). This is to remove any crystals adhering to the wall of the flask and to transfer them to the crucible. Care should be taken during this operation that the filter is not allowed to dry out, until the rinsing of the flask is complete. When completed, stop the suction as soon as the crystals have drained, so that the minimum quantity of air is drawn over them. Dry the crucible and its contents to constant weight (*x* gm.) at 60° C. in the oven

$$\text{Percentage } p,p'\text{-isomer w/w} = \frac{(x-y) \times 100}{w} = z$$

Where y = weight in grams of the empty crucible.

The determination should be carried out in triplicate, the results should not differ by more than 2 percent, and the mean figure should be taken.

Precision of results

The results should be expressed as follows:

Content of *p,p'*-isomer = (z ± 0.002z) percent.

NOTE 1. The temperature T is normally 25° ± 0.1° C., but any suitable temperature may be used. In hot climates it is more convenient to choose 0° C. and to use a melting ice bath instead of a constant temperature water bath.

NOTE 2. Certain active carbons are not suitable because they retain DDT. Therefore, it is wise before using a fresh batch or source of supply to check that the carbon does not absorb DDT. Acticarbone S supplied by Société CECA, 24, rue Murillo, Paris (8e) is satisfactory. Collaborative analyses, carried out by CPAC, used this material. The Belgian Committee has also found that decolorizing charcoal supplied by May & Baker, Dagenham, Essex, England, is satisfactory.

NOTE 3. It sometimes happens that sintered crucibles porosity G3 allow very fine carbon to pass through; in this case use a G4 for filtering the acetone solution.

NOTE 4. The crucible should be allowed to empty after each washing, and the carbon residue should be pressed down with the flat end of a glass rod.

NOTE 5. To prevent loss of DDT do not exceed this temperature.

NOTE 6. Some analysts use a filter of porosity G2 in order to carry out the filtration very rapidly, but if this is done, make sure that no fine crystals of *p,p'*-DDT pass through the filter.

Determination of acetone-insolubles

Reagent

Acetone, anhydrous

Apparatus

250 ml. flat-bottomed flask, fitted with ground glass neck

Reflux condenser to fit

Gooch crucible, with a sintered glass plate of porosity 15 to 40 microns
Oven at 110° C.
Desiccator
200 ml. measuring cylinder
750 ml. conical flask

Procedure. Weigh out 5 gm. of the dry sample (w gm.) and place in the clean, dry 250 ml. flask. Add acetone (150 ml.) and warm under reflux for 30 minutes. Filter the solution through the tared crucible (x gm.) and wash the residue in the crucible three times with acetone (3 × 100 ml.).

Dry the crucible in the oven at 110° C. for 30 minutes, allow to cool in the desiccator, and reweigh (z gm.).

Percentage acetone-insoluble material in the sample w/w $= \frac{100\ (z - x)}{w}$

OUTBREAKS AND NEW RECORDS

ISRAEL

H. N. Plaut, Agricultural Experiment Station, Nve-Yaar, Israel

The Hula rice borer - a new pest of rice[1]

In 1955, rice was grown experimentally for the first time in a small plot in the area reclaimed from the Hula swamps in Upper Galilee. Since then the rice-growing area has increased in this region every year, reaching 300 hectares in 1959. From the beginning, plants with withered heads were observed and the connection between this symptom and the occurrence of stem boring was noted by growers. Until 1957, the damage caused was negligible. In 1958, losses were estimated by the growers to be 3 and 15 percent respectively in early and late sowings. In 1959, the total loss was estimated to reach 33 percent.

The damage is caused by a lepidopterous stalk borer, identified by W.H. Tams of the British Museum (Natural History), London, as a hitherto unknown species of the genus *Chilotraea*, similar to *C. bandra*.

It seems reasonable to assume that this insect belongs to the endemic fauna of the Hula swamps. It undoubtedly found extremely favorable environmental conditions in the newly established rice fields.

In the laboratory, ten pairs of moths were bred at temperatures fluctuating between 17.5° and 30° C. The males lived from 2 to 10 (average 6) days and the females 1 to 6 (average 4.5) days. The preoviposition period was up to 2 (average 1.3) days. The number of eggs laid by one female varied from 96 to 404 (average 262) and one of the females included in the test did not oviposit. In glass jars the eggs were glued to the upper or lower side of the rice leaf or to the glass wall, in groups of up to approximately 200 but usually much less. At room temperatures fluctuating between 23° and 34° C., incubation of eggs required 4 days and development of larvae about 4 weeks.

Of the many hundreds of young larvae laid by moths in captivity and reared first on young sorghum and maize plants in the field and later on stalks in glass jars, only three reached the adult stage. On the other hand, many larvae collected from rice fields and fed on stalks of sorghum and maize developed into moths.

In general, the annual life cycle of this borer is similar to that of other species, such as *Pyrausta nubilalis* Hbn. and *Sesamia cretica* Wlk., which are the better known lepidopterous stalk borers of summer Gramineae in Israel. The main features include the diapause of the larvae from autumn to spring, the pupation and emergence of moths in spring, followed by a succession of two to four generations, until the onset of larval diapause in the stalks in late summer or autumn.

Control trials with different insecticides and methods of application carried out during 1959 did not yield conclusive results.

[1] Publication of the National and University Institute of Agriculture, Rehovot, 1961, No. 379-E.

PLANT QUARANTINE ANNOUNCEMENTS

AUSTRALIA

Statutory Rule 1961, No. 29, published in the *Commonwealth Gazette* on 6 March 1961, amends Regulation 21 of the Quarantine (Plants) Regulations concerning the importation of seeds. *Dolichos lablab* has been added to the list of seeds that may be imported only under permit issued by the Director of Quarantine, provided it is free from *Xanthomonas phaseoli, X. phaseoli* var. *fuscans, Pseudomonas medicaginis* var. *phaseolicola, Corynebacterium flaccumfaciens, Colletotrichum lindemuthianum* and mosaic virus.

FEDERATION OF MALAYA

The Plant Importation Rules of 9 February 1961, published in the *Legislative Supplement* No. 10 of the *Gazette*, Vol. V, No. 4 on 23 February 1961, was made under the authority of the Agricultural Pests and Noxious Plants Ordinance, 1953. The Southeast Asia and Pacific Region and the American tropics are defined as in the Plant Protection Agreement for the Southeast Asia and Pacific Region.

General provisions

CERTIFICATION

Importation of any plant, except those unrestricted, must be covered by a permit in prescribed form issued in advance by the Director of Agriculture, and each consignment must be accompanied by a certificate from the plant protection service of the country of origin, within 14 days prior to dispatch of the consignment.

PORTS OF ENTRY

Sea: Penang, Port Swettenham.
Air: Kuala Lumpur, Bayan Lepas.
Land: Johore Bahru, Changlun, Padang Besar, Kroh, Rantau Panjang.

Hevea rubber

Any plant (including seed) of *Hevea* spp. may be imported only for scientific purposes. The importation must be referred in advance by the Director of the Rubber Institute of Malaya and consigned to the Director of Agriculture. The plant must have been disinfected and free from any original soil in the country of origin. The accompanying certificate should bear a declaration that these requirements have been fulfilled.

Any plant capable of further growth (except seed) from the American tropics or any other region in which South American leaf blight (*Dothidella ulei*) occurs must, in addition, have been grown for an adequate period at an intermediate quarantine station approved by the Director of Agriculture, and found to be free from pests. A certificate to this effect signed by the officer in charge of such station must accompany the consignment.

Seed from the American tropics or any other region in which South American leaf blight occurs must have been examined and disinfected again at an approved intermediate place and repacked with new packing material and new containers. A certificate to this effect must accompany such seed.

Any plant not capable of further growth may be imported for legitimate special purposes and must have been sterilized in the country of origin by a satisfactory method. It is subject to all requirements for import of rubber plants, except approval by the Director of the Rubber Research Institute.

Plants other than *Hevea* from the American tropics

Plants from the American tropics or any other region in which South American leaf blight occurs may be imported only if they

have been subject to an approved form of quarantine or treatment at an intermediate place and found free from pests. A certificate to this effect must accompany the shipment, which must be consigned to the Director of Agriculture.

Cocoa

Any plant of cocoa (*Theobroma cacao*) or any plant known or likely to be hosts of swollen shoot or other cocoa viruses (including species of *Bombax, Cola, Corchorus, Herrania, Hibiscus, Sterculia, Theobroma* and *Abroma angusta, Adansonia digitata, Ceiba pentandra, Firmiana barteri, Heliocarpus popayanesis, Pterygota macrocarpa, Wissadula amplissima*) may be imported only for scientific purposes. Such plants should have been subject to an approved form of quarantine and found to be free from pests at an approved place outside the American tropics, the West African cocoa region, and any other territory in which cocoa virus diseases are known to occur. A certificate to this effect must accompany the shipment, which must be consigned to the Director of Agriculture.

Pests and soil

Importation of any pest or soil, whether alone or attached to a plant, is prohibited, except when imported by the Director of Agriculture for scientific purposes.

Plants imported by aircraft

Such plants must be consigned to the Director of Agriculture. This restriction does not apply to fresh fruits and vegetables for consumption from Australia, cut flowers from Indonesia, and fresh fruits for consumption from Thailand and Indonesia, excluding bananas and pineapples.

Imports unrestricted

1. Any plant imported for food or for analytical, medicinal or manufacturing purposes, except those specifically provided in the rules.
2. Cut flowers, except those restricted under importation by air.

Plants in transit

Plants in transit shall not be removed from the vehicle of transport unless permitted by the Director of Agriculture. Transshipment of any pest or plant in transit is prohibited, except as approved by the Director of Agriculture. Such pest or plant must be packed in a sealed, closed or wrapped container to prevent the escape of the pest.

Contravention

Plants listed below, if imported in contravention to the rules, will be detained and destroyed. Plants not listed, if imported in contravention, will be detained and disposed in a way determined by the Director of Agriculture.

Ananas comosus (pineapple)
Camellia sinensis (tea)
Citrus spp. and allied genera
Coffea spp.
Elaeis guineensis (oil palm)
Gossypium spp. (cotton)
Hevea spp. (rubber)
Ipomoea batatas (sweet potato)
Musa spp.
Saccharum officinarum (sugar cane)
Theobroma spp. (cocoa)
Cocos nucifera
Solanum tuberosum
Oryza sativa
Colocasia esculenta

Plants imported by aircraft, except those specifically permitted
Plants grown in the American tropics and the West African cocoa region
Host plants of cocoa viruses listed under Cocoa

FRANCE (Algeria)

A Decree of 17 February 1961, published in the *Recueil des actes administratifs* Vol. 4, No. 20 on 10 March 1961, replaces Decrees of 30 September 1949 and 2 November 1950. By the new decree, the potato root eelworm, *Heterodera rostochiensis*, is added to the list of animal pests from which crops in Algeria must be protected. Importation of potato tubers

and horticultural plants into Algeria from countries where the potato root eelworm is known to occur is authorized only if the consignment is accompanied by a phytosanitary certificate, attesting that it originates from a region which is free from potato root eelworm.

A Decree of 7 April 1961, published in the *Recueil des actes administratifs* Vol. 4, No. 34 on 28 April 1961, amends the Order of 28 June 1948 with regard to the importation of *Citrus* into Algeria in order to prevent the introduction of infectious degeneration of citrus (tristeza, quick decline, graft incompatibility). The importation of plants, parts thereof (except fruit) of the subfamily Aurantioideae of the family Rutaceae is prohibited. Exemptions from this regulation may be granted for imports intended for experimental purposes, provided a permit has been obtained in advance from the General Delegation in Algeria.

A Decree of 30 June 1961, published in the *Recueil des actes administratifs* Vol. 4, No. 57 of 18 July 1961, amends the Decree of 8 November 1945 by adding blue mold (*Peronospora tabacina*) to the list of pets and diseases from which crops in Algeria must be protected. Any plants and parts thereof from countries where blue mold is present may be imported only with a special permit indicating the customs offices for entry and conditions of admission.

SWEDEN

1. Statutory Order No. 14 of 27 January 1961, published in the *Svensk Författningssamling* No. 14 of 24 February 1961, amends Order No. 229 of 28 May 1959 (see *FAO Plant Prot. Bull.* 8: 33, 1959). The change concerns the importation of fresh fruit. Fresh fruit slightly infested with woolly aphids (*Eriosoma lanigerum*) may be imported during the whole year and fresh fruit slightly infested with San José scale (*Quadraspidiotus perniciosus*), Oriental fruit moth (*Laspeyresia molesta*) or Mediterranean fruit fly (*Ceratitis capitata*) may be imported during the period from 1 October to 31 March.

2. A State Plant Protection Institute Circular No. 1/1961 dated 20 July 1961 concerns the application of the Orders No. 229 of 28 May 1959 and Order No. 14 of 27 January 1961. The main changes, compared with a similar circular No. 1/1959 of 30 June 1959, are as follows.

Imports restricted

(*a*) Areas considered to be free from San José scale. Those parts of Spain which are not within the San José scale protection zone have been added to the list of countries or parts of countries which until further notice are considered to be free from this pest.

(*b*) Imports from countries or parts of countries where Colorado beetle, Japanese beetle, or fall webworm occur.

(*i*) Bud wood, flower bulbs and corms, strawberry plants, hardy perennials and forest plants for planting or propagation which have been cultivated outdoors or in frames, if imported during the period 1 April to 30 September, must be treated before packing with DDT or another approved pesticide.

(*ii*) Seed potatoes imported during the period 1 April to 30 October must be disinfested but DDT or other preparations of equal or greater toxicity may not be used. One of the approved insecticides is rotenone.

(*iii*) Woody nursery plants may be imported only from 1 October to 31 March. This period may be extended when climatic conditions in the exporting country permit such importation without risk. Imports during the prolonged period must be treated as for hardy perennials.

Points of entry

(*a*) *With inspectors constantly available:* Gothenburg, Hälsingborg, Landskrona, Malmö, Stockholm, and Trelleborg.

(*b*) *With inspectors not constantly available:* Gävle, Halmstad, Hudiksvall, Kalmar,

Karlshamn, Karlskrona, Karlstad, Kristianstad, Luleå, Norrköping, Sundsvall, Umeå, Varbeg, Visby, Örnsköldsvik, and Ostersund.

Inspection and certification

(*a*) Raw vegetables will be inspected but no certificate is required.

(*b*) Fresh fruit and berries imported during the winter period infested slightly with San José scale, Mediterranean fruit fly or Oriental fruit moth, may not be stored or marketed beyond 31 March.

UNITED STATES

Foreign Quarantine Notices summarized below amend Qarantine 37, relating to the importation of nursery stock, plants and seeds.

1. Foreign Quarantine Notice of 24 January 1961, published in the *Federal Register*, Vol. 26, No. 17 on 27 January 1961, restricts further the importation of *Juniperus* and *Pyrus* species from Canada, by imposing the post-entry quarantine requirements upon such plants. Previously, Canada was exempted from such requirements. This amendment was made because the pear-juniper rust, *Gymnosporangium fuscum*, is now known to exist in British Columbia.
2. Foreign Plant Quarantine Notice of 16 August 1961, published in the *Federal Register*, Vol. 26, No. 160 on 19 August 1961, removes alfalfa seed from the items that may be imported into the United States without formal permit, and adds it to the items that may be imported only under permit and after specific treatment. As a condition of entry, alfalfa seed must be treated upon arrival with thiram or other chemical or method found to be effective in eliminating fungus infection. This provision aims at preventing the entry of an alfalfa disease caused by a strain of *Verticillium albo-atrum*, which is causing severe losses in Europe.
3. Foreign Plant Quarantine Notice of 28 July 1961, published in the *Federal Register*, Vol. 26, No. 148 on 3 August 1961, amends the definition of "bulbs." Bulbs are now defined as the underground portions of plants commonly known as bulbs, corms, rhizomes, tubers and pips, including fleshy roots or other underground fleshy growths, a unit of which produces an individual plant. This amendment adds several genera and species to the items permitted entry as bulbs.

Administrative instructions listing genera or species of plants having underground portions conforming to the definition of bulbs were published on the same date. The list contains 192 genera from 20 families. *Anemone* is included but importation of this genus from Germany is prohibited. *Gladiolus* is also included but its importation from African sources is prohibited.

NEWS AND NOTES

INTERNATIONAL HORTICULTURAL CONGRESS

The Sixteenth International Horticultural Congress will be held in Brussels, Belgium, from 31 August to 8 September 1962, under the auspices of the International Society for Horticultural Sciences. The Congress will celebrate the centenary of the First International Horticultural Congress, also held in Belgium.

General discussions and presentation of papers will be organized in the following sections:

1. Vegetable growing
2. Fruit growing
3. Flower growing
4. Arboriculture
5. Tropical and subtropical horticultural crops

Under each section, the main aspects of the respective crops will be discussed, including the problems of pest, disease, and weed control.

General excursions to important Belgian horticultural centers will be organized before, during, and after the Congress.

For further information, inquiries should be addressed to the Secretary, XVIth International Horticultural Congress, 233, Coupure links, Ghent, Belgium.

EUROPEAN SYMPOSIUM ON FRUIT TREE VIRUS DISEASES

The Fifth European Symposium on Fruit Tree Virus Diseases, organized by the Institute of Plant Pathology of the University of Bologna, will be held at Bologna from 1 to 8 June 1962.

This symposium will be devoted to virus diseases of pome and stone fruits only, with special reference to European conditions. Communications to be presented at the meeting should concern original research, disease surveys, or observations on disorders of unknown cause but suspected of being of virus nature. Only papers on original research will be published after the symposium.

During the symposium, several excursions will be made to the fruit-growing areas in the vicinity of Bologna.

Further information on the symposium may be obtained from Dr. A. Canova, Istituto di Patologia Vegetale, Università di Bologna, Bologna, Italy.

Stabilimento Tipografico Fausto Failli - Roma - Via Tuscolana, 128

AGRICULTURAL AND HORTICULTURAL SEEDS

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